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THE MARINE BIOLOGICAL LABORATORY

WOOD'S HOLL, MASSACHUSETTS.

INCORPORATED 1888.

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1896-99

NINTH SEASON, 1896.

JUNE 1—OCTOBER 1.

C. O. WHITMAN, DIRECTOR,

Head Professor of Zoölogy, University of Chicago; Editor of the JOURNAL OF MORPHOLOGY.

JAMES I. PECK, ASSISTANT DIRECTOR,

Assistant Professor of Biology, Williams College.

W. H. MUNSON, CURATOR,

Professor of Biology, Hillsdale College.

OFFICERS OF INSTRUCTION.

ZOÖLOGY.

A. INVESTIGATION.

HOWARD AYERS, *Professor of Biology, University of the State of Missouri.*

E. G. CONKLIN, *Professor of Zoölogy, University of Pennsylvania.*

W. A. LOCY, *Professor of Biology, Northwestern University.*

M. M. METCALF, *Professor of Biology, The Woman's College of Baltimore.*

C. M. CHILD, *Assistant in Histology, University of Chicago.*

F. R. LILLIE, *Instructor in Zoölogy, University of Michigan.*

O. S. STRONG, *Instructor in Zoölogy, Columbia College.*

H. S. BRODE, *Fellow in Zoölogy, University of Chicago.*

H. E. CRAMTON, *Assistant in Biology, Massachusetts Institute of Technology.*

B. INSTRUCTION.

ULRIC DAHLGREN, *Instructor in Biology, Princeton University.*

CHAS. W. GREENE, *Instructor in Biology, Leland Stanford University.*

LEWIS MURBACH, *Fellow and Assistant in Zoölogy, University of Chicago.*

W. H. PACKARD, *Fellow in Zoölogy, University of Chicago.*

BOTANY.

J. M. MACFARLANE, *Professor of Botany, University of Pennsylvania.*

H. C. PORTER, *Assistant Professor of Botany, University of Pennsylvania.*

J. E. HUMPHREY, *Instructor in Botany, Johns Hopkins University.*

G. T. MOORE, JR., *Assistant in Botany, Harvard University.*

K. HYASHI, *Artist.*

E. C. WALDEN, *Collector.*

G. M. GRAY, *THE LIBRARY OF THE*
Library Assistant.

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UNIVERSITY OF ILLINOIS
Natural History Survey
Library

GENERAL INFORMATION.

The Laboratory was opened in the summer of 1888 for the use of students and investigators in Marine Zoölogy. Departments of Botany and Physiology have since been added. The work is now organized with reference to the needs of three classes of workers, namely, (1) students, (2) teachers of science, and (3) investigators. Regular courses of instruction, consisting of lectures and laboratory work under the supervision of the instructors, are given in Zoölogy, Botany and Embryology. In addition to these, there will be courses of lectures on special subjects. There will also be evening lectures on biological subjects of general interest. Among those who may contribute these lectures may be mentioned, in addition to the instructors above named, the following:

G. F. ATKINSON, *Cornell University.*

E. G. CONKLIN, *University of Pennsylvania.*

J. M. COULTER, *University of Chicago.*

W. M. DAVIS, *Harvard University.*

A. E. DOLBEAR, *Tufts College.*

SIMON FLEXNER, *Johns Hopkins Hospital.*

F. S. LEE, *Columbia College.*

W. A. LOCY, *Lake Forest University.*

J. M. MACFARLANE, *University of Philadelphia.*

C. S. MINOT, *Harvard Medical School.*

E. S. MORSE, *Peabody Academy of Science.*

H. F. OSBORN, *Columbia College.*

W. B. SCOTT, *Princeton College.*

GEO. M. STERNBERG, *Surgeon-General U. S. Army.*

W. T. SEDGWICK, *Massachusetts Institute of Technology.*

E. B. WILSON, *Columbia College.*

B. G. WILDER, *Cornell University.*

W. P. WILSON, *University of Pennsylvania.*

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WOOD'S HOLL.

Wood's HOLL is situated on the north shore of Vineyard Sound, at the entrance of Buzzard's Bay, and may be reached by the Old Colony Railroad (two and one-half hours from Boston), or by rail and boat from Providence, Fall River, or New Bedford. Rooms accommodating two persons may be obtained near the Laboratory, at prices varying from \$1.00 to \$3.00 a week, and board from \$4.00 to \$6.00. Board will be supplied to members at The Homestead at \$5.00 a week.

The location of the Laboratory at Wood's Holl gives it exceptional advantages for study and research. The shore is varied by necks, points, flats, gutters, holes, bays and islands; there are numerous fresh-water ponds and lakes in the vicinity; there is no muddy river or city sewage to pollute the sea-water; the fauna and flora are exceptionally rich; the climate is especially favorable for summer work; and the place is free from the inconveniences and distractions of fashionable summer resorts.

THE LABORATORY.

The Laboratory consists of four two-story buildings, with forty private rooms for the exclusive use of investigators, and seven general laboratories. It is supplied with aquaria, collecting apparatus, reagents, glassware, and a limited number of microtomes and microscopes for use in the introductory courses. The investigators' rooms are furnished with glassware and reagents, but not with microscopes and microtomes. *No alcohol is supplied beyond what is allowed for the work done in the laboratories; and expensive reagents, such as osmic acid and gold chloride, are not included in the list of free reagents.*

The Laboratory has a steam launch, boats, dredges, and all the apparatus necessary for collecting and keeping alive material reserved for class work or research.

LIBRARY.

The Library is provided with many works of reference and the more important journals of Zoölogy and Botany, some of them in complete series. Members of the Laboratory are allowed the use of books from the Library of the Boston Society of Natural History, through the courtesy of the Curator and the Librarian.

LABORATORY SUPPLY.

A Department of Laboratory Supply has been established in order to facilitate the work of teachers and others at a distance who desire to obtain material for study or for class instruction. Certain sponges, hydroids, star-fishes, sea-urchins, marine worms, crustaceans, molluscs, vertebrates, and marine plants are generally kept in stock, though larger orders should be filed some time before the material is needed. Circulars giving information, prices, etc., may be obtained on application to the Curator, Prof. W. H. MUNSON, Hillsdale, Mich. (June to October, Wood's Holl, Mass.)

MS A.9.1896, v.12.1899, v.21.1900, v.25.1912 cont'd.

THE LABORATORIES FOR INVESTIGATORS.

The forty private Laboratories are distributed as follows :

Zoölogy	-	-	-	-	-	22
Physiology	-	-	-	-	-	8
Botany	-	-	-	-	-	10

These rooms are rented at \$100 to colleges, societies or individuals.

The general laboratories are for the use of students engaged in special research under the supervision of the Director and his assistants, and for advanced courses preparatory to beginning investigation, such as the course in Embryology. There are forty-two tables, of which Zoölogy has twenty-two, Physiology ten, and Botany ten.

EMBRYOLOGY.

JULY 1—AUGUST 12.

For the course in Embryology, the introductory course in Zoölogy or its equivalent, is a prerequisite. The course is designed as a preparation for beginning investigation, and will combine the study of the living egg with that of prepared material. The aim will therefore be, not only to master the details of development, but also to acquire a thorough knowledge of the methods of preparing surface views, imbedding in paraffin and celloidin, staining and mounting, drawing, reconstructing, modelling, etc. The study will be mainly confined to the fish egg as the best type for elucidating vertebrate development; but the eggs of amphibia and other vertebrates as well as some invertebrates will receive attention. Each member of the class will be supplied with material and be expected to work out the successive steps in development, beginning with the egg just after fertilization. The laboratory work will be conducted by Doctors Lillie and Strong, and accompanied with lectures and Seminar work under the Director. The fee for this course is \$50, and the class is limited to eighteen.

Applicants should state what they have done in preparation for such a course, and whether they can bring a complete outfit, viz.: a compound microscope, a dissecting microscope (the Paul Mayer pattern made by Zeiss is the best), camera-lucida, microtome, etc. In case these instruments are furnished by the Laboratory, an additional fee of ten dollars will be charged therefor. No application for less than the whole course will be granted.

Applications should be made to Prof. C. O. Whitman, University of Chicago, Chicago, Ill.

INVESTIGATION.

JULY 1—AUGUST 12.

For those prepared to begin original work, ten tables are reserved in Zoölogy, and the same number in Botany. The introductory and preparatory courses in each department, or an equivalent, are prerequisites for admission to these tables. Ability to read scientific German and French is also required.

Special subjects for investigation are assigned to the occupants of tables, and the supervision of the work is so divided that each instructor has the care of but three or four students. In this way all the advantages of individual instruction are secured. All the lectures and the Seminar are open to those engaged in such work. The fee is \$50.

Applications directed as above.

THE SEMINAR.

The Seminar is especially designed for the class in Embryology and beginners in investigation, but is open to all. It is expected that all who attend will be provided with the fourth volume of the *Biological Lectures*¹, as this will be made the basis of discussion. Most of the authors of these lectures will be present, and from two to three mornings will be devoted to the consideration of each lecture, and such questions as may be raised.

THE LABORATORY FOR TEACHERS AND STUDENTS IN ZOÖLOGY.

JULY 1—AUGUST 12.

This course will embrace a study of the more typical marine animals, instruction being given by *lectures, laboratory work, and collecting excursions.*

The lectures are given each morning and by those who are specialists in the subject under consideration. For laboratory dissection, each student is supplied with fresh material, and the entire day is spent in study, under the direction of the instructors. Collecting excursions are taken on Wednesdays and Saturdays. The steam launch and boats are freely used, and methods of dredging, skimming, and general collecting are explained.

The course of instruction will be as follows:

- July 1-2. Protozoa.
- July 3-9. Coelenterata (Granatia, Pennaria, Campanularia, Metridium, Mnemeopsis).
- July 10-11. Platodes (Bdelloura, Distoma).
- July 13-17. Vermes (Nereis, Phascolosoma, Polyzoa).
- July 18-24. Mollusca (Mya, Sycotypus, Loligo).
- July 25-30. Echinodermata (Asterias, Arbacia, Thyone).
- July 31-August 8. Crustacea (Branchipus, Lepas, Orchestia, Idotea, Palaemonetes, Cancer, Limulus).
- August 9-12. Tunicata (Molgula).

The fee for this course is \$50.00, payable in advance. It covers tuition, material for dissection, laboratory outlines, and a supply of glassware and reagents. The laboratory loans, without charge, microtomes and certain other apparatus; there is a small fee, however, for the use of microscopes, and all who can provide themselves with simple and compound microscopes before coming to Wood's Holl are urged to do so.

Applications should be made, at the earliest convenient date, to

PROFESSOR JAMES I. PECK (until July 1), Williams College, Williamstown,
Mass.; July 1-September 1, Wood's Holl, Mass.

¹Published by Ginn & Co., Boston, Mass.

CO-OPERATING COLLEGES AND SOCIETIES IN 1894 AND 1895.

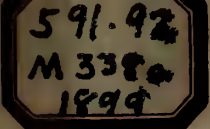
American Medical Missionary College.	Northwestern University.
Boston University School of Medicine.	Princeton University.
Brown University.	Smith College.
Bryn Mawr College.	Syracuse University.
College of Medicine, Syracuse University.	University of Chicago.
College of Physicians and Surgeons, Columbia College.	University of Cincinnati.
Columbia College.	University of Pennsylvania (Provost Harrison).
Hamilton College.	University of Texas.
Lake Forest University.	Vassar College.
Massachusetts Institute of Technology.	Wellesley College.
Miami University.	Williams College.
Missouri Botanical Garden.	Woman's College, Baltimore.
Mt. Holyoke College.	
American Association for Advancement of Science.*	
American Society of Naturalists.	
Beta Alpha Chapter of the K. K. G. Fraternity of the University of Pennsylvania.	
Lucretia Crocker Scholarship.	
Woman's School Alliance, Milwaukee.	

TRUSTEES.

SAMUEL H. SCUDDER, <i>President</i> ,	- - -	Boston Society of Natural History.
LAURENCE MINOT, <i>Treasurer</i> ,	- - -	39 Court St., Boston, Mass.
ANNA PHILLIPS WILLIAMS, <i>Secretary</i> ,	- - -	23 Marlborough St., Boston.
C. O. WHITMAN, <i>Director of the Laboratory</i> ,	- - -	University of Chicago.
W. K. BROOKS,	- - -	John Hopkins University, Baltimore.
SAMUEL F. CLARKE,	- - -	Williams College, Williamstown.
FLORENCE M. CUSHING,	- - -	Boston.
WILLIAM G. FARLOW,	- - -	Harvard University, Cambridge.
EDWARD G. GARDINER,	- - -	Boston.
WILLIAM LIBBEY, JR,	- - -	College of New Jersey, Princeton.
J. PLAYFAIR McMURRICH,	- - -	University of Michigan, Ann Arbor.
CHARLES S. MINOT,	- - -	Harvard Medical School, Boston.
L. L. NUNN,	- - -	Telluride, Colorado.
WILLIAM T. SEDGWICK,	- - -	Massachusetts Institute of Technology, Boston.
GEORGIANA W. SMITH,	- - -	Boston.
SIDNEY I. SMITH,	- - -	Yale University, New Haven.
WILLIAM TRELEASE,	- - -	Missouri Botanical Gardens, St. Louis, Mo.
EDMUND B. WILSON,	- - -	Columbia College, New York.
W. P. WILSON	- - -	University of Pennsylvania.
R. RAMSAY WRIGHT,	- - -	University of Toronto.

The Annual Report, containing an account of the organization and work of the Laboratory, may be obtained from the Secretary.

* Application for the A. A. A. S. Room is to be made to the Secretary of the Association, Prof. F. W. Putnam, Cambridge, Mass.



THE MARINE BIOLOGICAL LABORATORY

WOOD'S HOLL, MASSACHUSETTS

INCORPORATED IN 1888

TWELFTH SESSION, 1899

JUNE 1—OCTOBER 1

C. O. WHITMAN, DIRECTOR,
Professor of Zoölogy, The University of Chicago.

ULRIC DAHLGREN, ASSISTANT DIRECTOR,
Assistant Professor of Histology, Princeton University.

OFFICERS OF INSTRUCTION

ZOÖLOGY

1. MORPHOLOGICAL AND EMBRYOLOGICAL RESEARCH

HOWARD AYERS, *Professor of Biology, University of the State of Missouri.*
E. G. CONKLIN, *Professor of Comparative Embryology, University of Pennsylvania.*
M. M. METCALF, *Professor of Biology, The Woman's College of Baltimore.*
THOMAS H. MONTGOMERY, JR., *Instructor in Biology, University of Pennsylvania.*
T. H. MORGAN, *Professor of Biology, Bryn Mawr College.*
A. D. MORRILL, *Professor of Biology, Hamilton College.*
WM. PATTEN, *Professor of Biology, Dartmouth College.*

2. CYTOLOGICAL RESEARCH

SHO WATASÉ, *Professor of Cellular Biology, The University of Chicago.*
W. H. PACKARD, *Instructor in Biology, Bradley Institute of Technology.*

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3. EMBRYOLOGY

- F. R. LILLIE, *Instructor in Zoölogy, University of Michigan.*
O. S. STRONG, *Instructor in Zoölogy, Columbia University.*
H. E. CRAMPTON, *Lecturer in Zoölogy, Columbia University.*
A. L. TREADWELL, *Professor of Biology, Miami University.*
CORNELIA M. CLAPP, *Professor of Biology, Mt. Holyoke College.*

4. ANIMAL MORPHOLOGY

- ULRIC DAHLGREN, *Instructor in Histology, Princeton University.*
GEORGE LEFEVRE, *Adam Bruce Fellow, Johns Hopkins University.*
LEWIS MURBACH, *Detroit High School, Detroit, Michigan.*
F. C. WAITE, *Assistant in Invertebrate Zoölogy, Harvard University.*
ROBERT W. HALL, *Assistant in Vertebrate Anatomy, Harvard University.*
JAMES H. MCGREGOR, *Fellow in Zoölogy, Columbia University.*
FRED C. PAULMIER, *Fellow in Zoölogy, Columbia University.*
WINTERTON C. CURTIS, *Graduate Student, Johns Hopkins University.*

GENERAL AND COMPARATIVE PHYSIOLOGY

- JACQUES LOEB, *Professor of Physiology, The University of Chicago.*
W. W. NORMAN, *Professor of Animal Biology, University of Texas.*
E. P. LYON, *Professor of Physiology, Bradley Institute of Technology.*
ALBERT P. MATHEWS, *Associate Professor of Physiology, Tuft's College.*

COMPARATIVE PSYCHOLOGY

- EDUARD THORNDIKE, *Instructor in Genetic Psychology, Columbia University.*

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BOTANY

1. CRYPTOGAMIC BOTANY. 2. PLANT CYTOLOGY

BRADLEY MOORE DAVIS, *Instructor in Botany, The University of Chicago.*

GEORGE T. MOORE, JR., *Assistant in Botany, Harvard University.*

3. A COURSE OF LECTURES ON PLANT MORPHOLOGY AND PHYSIOLOGY

GEORGE F. ATKINSON, *Professor of Botany, Cornell University.*

DOUGLAS H. CAMPBELL, *Professor of Botany, Stanford University.*

JOHN M. COULTER, *Professor of Botany, The University of Chicago.*

CLARA E. CUMMINGS, *Associate Professor of Botany, Wellesley College.*

HENRY KRAEMER, *Professor of Botany and Pharmacognosy, Philadelphia College of Pharmacy*

D. T. MACDOUGAL, *Director of the Laboratories, New York Botanical Garden.*

J. MUIRHEAD MACFARLANE, *Professor of Botany, University of Pennsylvania.*

DAVID M. MOTTIER, *Professor of Botany, Indiana University.*

D. P. PENHALLOW, *Professor of Botany, McGill University.*

ERWIN F. SMITH, *Pathologist, United States Department of Agriculture.*

C. O. TOWNSEND, *Maryland Experiment Station.*

RODNEY H. TRUE, *Assistant Professor of Botany, University of Wisconsin.*

L. M. UNDERWOOD, *Professor of Botany, Columbia University.*

HERBERT J. WEBBER, *Assistant Physiologist, United States Department of Agriculture.*

RHODA A. ESTEN, *Curator of the Herbarium.*

J. W. ALLEN, *Bursar.*

K. HAYASHI,
JOSEPH BRIDGHAM, } *Artists.*

G. M. GRAY, *Curator of Supply Department.*

LILLIAN G. MACRAE, *Collector in Botany.*

JOHN GORDON HUBBARD, *Photographer.*

GEORGE WM. HUNTER, JR., *Chemist.*

JOHN VEEDER, *Cockswain.*

Bausch & Lomb Optical Co. and Kny-Scheerer & Co. have agents located at Wood's Holl, from whom microscopes and other apparatus can be obtained.

GENERAL INFORMATION

The Laboratory was opened in the summer of 1888 for the use of students and investigators in Marine Zoölogy. Four departments are now organized for research and instruction, namely, Zoölogy, Physiology, Psychology, and Botany. The following *Courses of Instruction* are offered :

1. *Morphological and Embryological Research.*
2. *Cytological Research, or, Morphology and Physiology of the Cell.*
3. *Embryology.*
4. *Animal Morphology.*
5. *General and Comparative Physiology.*
6. *Comparative Psychology.*
7. *Plant Morphology and Physiology.*
8. *Cryptogamic Botany.*
9. *Plant Cytology and Micro-technique.*

The following Seminars and Lecture Courses are open to all members of the Laboratory :

1. *Neurological Seminar.*
2. *Biological Seminar.*
3. *Botanical Seminar.*
4. *Lectures on Zoölogical Technique.*
5. *Evening Lectures.*

The Evening Lectures are given by members of the staff and by others from the following list of regular or occasional contributors :

- | | |
|--|---|
| J. A. ALLEN, <i>Director of Am. Mus. Nat. History, New York.</i> | F. S. LEE, <i>Columbia University.</i> |
| G. F. ATKINSON, <i>Cornell University.</i> | WILLIAM LIBBEY, <i>Princeton University.</i> |
| L. H. BAILEY, <i>Cornell University.</i> | J. M. MACFARLANE, <i>University of Pennsylvania.</i> |
| H. C. BUMPUS, <i>Brown University.</i> | A. G. MAYER, <i>Harvard University.</i> |
| DOUGLAS H. CAMPBELL, <i>Stanford University.</i> | A. D. MEAD, <i>Brown University.</i> |
| J. MCK. CATTELL, <i>Columbia University.</i> | T. H. MONTGOMERY, JR., <i>University of Pennsylvania.</i> |
| C. M. CHILD, <i>The University of Chicago.</i> | E. S. MORSE, <i>Peabody Academy of Science.</i> |
| H. W. CONN, <i>Wesleyan University.</i> | A. E. ORTMANN, <i>Princeton University.</i> |
| J. M. COULTER, <i>The University of Chicago.</i> | H. F. OSBORN, <i>Columbia University.</i> |
| A. E. DOLBEAR, <i>Tufts College.</i> | WILLIAM PATTEN, <i>Dartmouth College.</i> |
| W. H. DUDLEY, <i>Wisconsin State Normal.</i> | D. P. PENHALLOW, <i>McGill University.</i> |
| C. H. EIGENMANN, <i>Indiana University.</i> | W. B. SCOTT, <i>Princeton University.</i> |
| SIMON FLEXNOR, <i>Johns Hopkins University.</i> | W. T. SEDGWICK, <i>Mass. Institute of Technology.</i> |
| KATHERINE FOOT, <i>Evanston, Ill.</i> | L. M. UNDERWOOD, <i>Columbia University.</i> |
| GEORGE L. GOODALE, <i>Harvard University.</i> | S. WATASÉ, <i>The University of Chicago.</i> |
| F. H. HERRICK, <i>Adelbert College.</i> | H. J. WEBBER, <i>U. S. Dept. of Agriculture.</i> |
| C. F. HODGE, <i>Clark University.</i> | W. M. WHEELER, <i>The University of Chicago.</i> |
| ALPHEUS HYATT, <i>Harvard University.</i> | B. G. WILDER, <i>Cornell University.</i> |
| J. S. KINGSLEY, <i>Tufts College.</i> | E. B. WILSON, <i>Columbia University.</i> |
| | W. P. WILSON, <i>Philadelphia Museums.</i> |

WOOD'S HOLL

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LIBRARY

The Library is provided with many works of reference and the more important journals of Zoölogy and Botany, some of them in complete series. Members of the Laboratory are allowed the use of books from the Library of the Boston Society of Natural History through the courtesy of the Curator and the Librarian.

The Library depends for its growth largely upon contributions from the friends of the Laboratory. The files of papers contributed by individual investigators are especially useful in the work of the Laboratory, and these files can only be kept complete by the aid of the donors themselves. Such aid will be greatly appreciated and duly acknowledged in the annual report of the Librarian.

MUSEUM

A Museum has been started in the main building with two objects in view:

1. To provide a collection of dissections which will assist students in their work. This collection is largely drawn from the dissections prepared by the class in Morphology.
2. To provide a collection of the fauna of the surrounding waters and country. This work will be done in connection with the Supply Department.

MICROSCOPIC PREPARATIONS

A collection of microscopic preparations, including histological, cytological, and embryological sections, and mounts *in toto*, would be of great service in the work of the Laboratory. In every piece of research the investigator accumulates such preparations in excess of his future needs, and could easily supply duplicates, often in series, that would be of permanent value for a cabinet collection. Every year the class in Embryology turns out many complete series of the stages of development in the fish, frog, amblystoma, etc. The class in Cytology will likewise be able to contribute to the proposed collection. We would therefore appeal to members of these classes, as well as to investigators, for aid in making this collection.

PUBLICATIONS

I. THE BIOLOGICAL LECTURES

Six volumes have thus far been issued, bearing, respectively, the following dates : 1890, 1893, 1894, 1895, 1896-7, and 1898. The contents of the volume for 1898 are as follows :

- I. E. B. WILSON, *The Structure of Protoplasm*.
- II. E. B. WILSON, *Cell-Lineage and Ancestral Reminiscence*.
- III. FRANK R. LILLIE, *Adaptation in Cleavage*.
- IV. EDWIN G. CONKLIN, *Protoplasmic Movement as a Factor of Differentiation*.
- V. A. L. TREADWELL, *Equal and Unequal Cleavage*.
- VI. A. D. MEAD, *Cell Origin of the Prototroch*.
- VII. CORNELIA M. CLAPP, *Relation of the Axis of the Embryo to the First Cleavage Plane*.
- VIII. THOMAS H. MONTGOMERY, JR., *Observations on Various Nucleolar Structures of the Cell*.
- IX. S. WATASÉ, *Protoplasmic Contractility and Phosphorescence*.
- X. T. H. MORGAN, *Some Problems of Regeneration*.
- XI. H. C. BUMPUS, *The Elimination of the Unfit*.
- XII. JACQUES LOEB, *Heredity of Coloration in Fishes*.
- XIII. W. W. NORMAN, *Do the Reactions of Lower Animals, Due to Injury, Indicate Pain Sensations ?*
- XIV. W. B. SCOTT, *North American Ruminant-like Animals*.
- XV. W. M. WHEELER, *Caspar Friedrich Wolff and the Theoria Generationis*.
- XVI. C. O. WHITMAN, *Animal Behavior*.

II. THE BIOLOGICAL BULLETIN

After the close of the current volume in April, the *Zoölogical Bulletin* will be continued under the title, the *Biological Bulletin*, and be published under the auspices of the Marine Biological Laboratory. The scope of the *Bulletin* will be enlarged so as to include General Biology, Physiology, and Botany. It will further include occasional reviews and reports of work and lectures at the Laboratory. The *Bulletin* will be open, as heretofore, to scientific contributions from any source.

III. ANNUAL REPORT AND PROGRAM

LABORATORY SUPPLY

A Department of Laboratory Supply has been established in order to facilitate the work of teachers and others at a distance who desire to obtain material for study, for class instruction, or for museum purposes. All the types generally used in zoölogical instruction, such as sponges, hydroids, star-fishes, sea-urchins, marine worms, crustaceans, molluscs, smaller marine vertebrates, etc., are kept in stock, though large orders should be filed, if possible, some time before the material is needed. Circulars giving information, prices, etc., may be obtained on application to Professor Ulric Dahlgren, Princeton, N. J. (June to October, Wood's Holl, Mass.)

COURSES OF INSTRUCTION

JULY 5 '10 AUG. 16

I. MORPHOLOGICAL AND EMBRYOLOGICAL RESEARCH

For those prepared to begin original work in morphological or embryological lines, tables are reserved in one of the general laboratories. Special problems are assigned to the occupants of tables and an instructor is appointed to guide and supervise the work in each case. The work of instruction will be shared by Drs. Montgomery, Ayers, Conklin, Metcalf, Morgan, Morrill, Patten, and Whitman.

The courses in Animal Morphology (4) and embryology (3), or an equivalent, are prerequisites for admission to these tables. Ability to read German and French is also required. The fee for the table, including reagents and glassware, is \$50.

Applications for tables should be directed to C. O. Whitman, The University of Chicago, or to Dr. T. H. Montgomery, Jr., University of Pennsylvania.

2. CYTOLOGICAL RESEARCH

MORPHOLOGY AND PHYSIOLOGY OF THE CELL

This course will be conducted by Professor Watasé, with the assistance of Mr. W. H. Packard. The course is designed for a limited number of students who are prepared to begin investigation. A special problem will be assigned to each member of the class, and methods of dealing with it will be suggested.

The laboratory work will be accompanied by a series of lectures on general cytological subjects, designed to give a view of the field of cellular biology as a whole, and at the same time to indicate the bearings of the problems under investigation. The lectures will be divided under three heads as follows:

1. *Introductory and General.*
2. *The Developmental Phenomena of Cell-life.*
3. *The Non-developmental Phenomena of Cell-life.*

I. Under the first head, the following topics will be considered: The scope of the modern cell-theory; protoplasm; the structure of the cell; the relation of the nucleus and the cytoplasm; theories of the function of the nucleus; the paranucleus, archoplasm, nucleolus, and chromatin; structural metamorphosis of the cytoplasm; comparative anatomy of the centrosome, etc.

II. Under the second head, the following: General history of the sexual cells; comparison of the sexual cells and tissue cells; life-history of the egg-cell; life history of the sperm-cell; phenomena of fertilization; cell-division and development; mitosis and amitosis; methods and criteria of histological differentiation; cytological aspects of regeneration and degeneration, etc.

III. Under the third head, the following: The structural basis of protoplasmic contractility (muscle, cilia, flagella, centrosome, spermatozoon, etc.); cytological aspects of secretion; phosphorescent phenomena of living substance; electrical organs and their relation to muscles; the cytology of connective tissues, skeletal tissues, sense-organs, etc.

Applicants should state what preparation they have had for such a course, and whether they can bring the following outfit: A compound microscope with oil immersion lens, a dissecting microscope, camera-lucida, microtome, etc.

The fee for this course is \$50.00.

Applications should be made to Dr. S. Watasé, the University of Chicago, until June 15; thereafter Wood's Holl, Mass.

3. EMBRYOLOGY

For the course in Embryology, the introductory course in Zoölogy, or *its equivalent*, is a prerequisite. The course is designed as a preparation for beginning investigation, and will combine the study of living eggs with that of prepared material. It serves to supplement the usual college course, and offers special advantages for comparative study in the way of material, which are available only at the seashore. The work will include fertilization, the different types of cleavage, and the more general features of development of both vertebrates and invertebrates. Special emphasis will be placed on experimental methods, and on the general tectonics of embryo formation. The study will begin with transparent pelagic fish eggs, as the best type for elucidating vertebrate development. The egg of *Fundulus* will follow, illustrating conditions intermediate between pelagic eggs and those of fresh-water fishes. The interesting eggs of the Toad-fish (*Batrachus*) will be introduced to show important modifications in development resulting from an increase in the volume of food-yolk. The eggs of the Frog will be studied as a type of amphibian development. The Skate's egg will serve to illustrate conditions leading to higher types.

The eggs of the Sea-urchin, marine Planarians, Molluscs (*Unio* and *Crepidula*), Annelids, Leeches, etc., will be introduced and studied in connection with lectures by Drs. Whitman, Loeb, Gardiner, Conklin, Lillie, Strong, Crampton, Treadwell, Mathews, Mead, Clapp, and Miss Foot.

The Laboratory work will be conducted by Drs. Lillie, Strong, Treadwell, Crampton, and Clapp.

The fee for this course is \$50.

Applicants should state what they have done in preparation for such a course, and whether they can bring a complete outfit, viz., a compound *microscope* with substage apparatus (condenser and *irisdiaphragm*) and nose-piece, a *dissecting microscope* (the Paul Mayer pattern made by Zeiss is the best), camera-lucida, *microtome*, etc. In case these instruments are furnished by the Laboratory, an additional fee of five dollars will be charged therefor. No application for less than the whole course will be granted.

Applications should be made to Dr. F. R. LILLIE, University of Michigan, Ann Arbor, Mich.

The following synopsis of the course in 1898 gives the ground usually covered:

COURSE IN EMBRYOLOGY—SEASON 1899.

DATE	LECTURER	SUBJECT OF LECTURE	LABORATORY WORK
June 29, Wed.	DR. WHITMAN.	Introductory: Theories of Epigenesis and Evolution. Purpose of Course.	Fertilization of Eggs; Early Cleavage Stages of Fundulus and Ctenolabrus.
30, Thur.	DR. STRONG.	Technique.	Ctenolabrus — continued.
July 1, Fri.	DR. LILLIE.	Cell-theory and Fertilization of Ovum.	Fundulus.
1, P.M.	DR. CLAPP.	Toad-fish.	Toad-fish.
2, Sat.	DR. LILLIE.	Origin of Centrosomes; Problem of Chromosomes; Maturation.	Examination of DR. WILSON's slides; Maturation in Nereis; Fertilization in Sea-urchin.
4, Mon.	DR. WHITMAN.	Yolk.	
5, Tues.			Pelagic Fish-eggs.
6, Wed.	DR. WHITMAN.	Continuation of Egg Development.	Fundulus.
7, Thur.			Molluscan Egg.
8, Fri.	PROF. TREADWELL.	Spiral Cleavage.	Experiments on Fundulus Egg.
9, Sat.	DR. WILSON.	Mechanical and Promorphological Conditions of Cleavage.	Experiments on Fundulus Egg.
11, Mon.	DR. CRAMPTON.	Experiments on Animal Eggs.	Experiments on Arbacia Eggs.
12, Tues.	DR. WHITMAN.	Comparison of Cleavage in <i>Amia</i> and <i>Ctenolabrus</i> . "Orientation is not dependent upon Type of Cleavage."	Preserving Fresh Material. Whole Mounts of Ctenolabrus.
13, Wed.	DR. WHITMAN.	Later Stages of Cleavage in Ctenolabrus.	Preserving, Mounting.
14, Thur.	DR. CLAPP.	Formation of Embryo of Toad-fish.	Quiz by DR. WHITMAN on Development of Embryo of Ctenolabrus.
15, Fri.			Preserving Fundulus, Mounting Ctenolabrus. Examination of Pelagic Eggs.
16, Sat.	DR. WHITMAN.	Formation of Embryo in Leech.	Discussion on Growth of Embryo. Whole Mounts.
18, Mon.	DR. WHITMAN.	Orientation.	Whole Mounts.
19, Tues.	DR. BUMPUS. DR. WHITMAN.	Embryology of Lobster. Metamerism.	Mounts. Paraffine Imbedding.
20, Wed.	DR. WHITMAN.	Concrescence and Blastopores.	Paraffine Imbedding.
21, Thur.	DR. LOEB.	Experiments with Arbacia.	Demonstration by DR. NORMAN of Arbacia Eggs in diluted and concentrated Sea-water.
23, Sat.			Paraffine Imbedding. Sectioning.
25, Mon.			Paraffine Imbedding. Sectioning.
26, Tues.	DR. CONKLIN.	1) Cleavage of <i>Crepidula plana</i> . 2) Formation of cross in <i>Crepidula</i> differs from that in the Annelids, but the arms alternate with the arms of the cross in Annelids. 3) Points of Agreement between Molluscan and Annelid Cleavage.	Sectioning.
27, Wed.	DR. CONKLIN.	Homologies between Molluscs, Gastropods, Annelids and Flatworms.	Demonstration by DR. CONKLIN of Eggs of <i>Crepidula</i> .

DATE	LECTURER	SUBJECT OF LECTURE	LABORATORY WORK
28, Thur.	DR. MEAD.	Annelid Ovum.	Demonstration of Chaetopterus by DR. MEAD.
29, Fri.	DR. WHITMAN.	KUPFFER'S Vesicle.	Sectioning, Mounts.
30, Sat.			Sectioning, Mounts.
Aug. 1, Mon.	DR. CONKLIN.	Theoretical Significance of Homology.	Study of Amphibian Egg.
2, Tues.	DR. MATHEWS.	Chemistry of the Reproductive Elements.	Amphibian Egg.
3, Wed.	DR. MONTGOMERY.	The Nucleolus.	Celloidin Imbedding.
4, Thur.	DR. WHITMAN.		Celloidin Imbedding.
5, Fri.			Celloidin Imbedding and Sectioning.
6, Sat.	DR. WHITMAN.	Informal Talk and Quiz on Growth of Germ-ring.	Celloidin Imbedding and Sectioning.
8, Mon.	DR. LILLIE.	Adaptation in Cleavage.	Celloidin Imbedding and Sectioning.
9, Tues.	DR. CONKLIN.	Mechanism of Differentiation.	Celloidin Sectioning.

4. THE LABORATORY FOR TEACHERS AND STUDENTS IN ANIMAL MORPHOLOGY

JULY 5 TO AUG. 16

JULY 5 TO AUG. 16

This course will consist of studies of the animal kingdom as represented in the vicinity of Wood's Holl, and will deal mainly with the morphology of marine invertebrates. A portion of the time will be devoted to the embryology, life history, distribution, and relationships of both living and extinct forms.

The laboratory work will be accompanied by lectures, and the regular staff of instructors will be reinforced by a number of investigators, who will take charge of the work in their special lines.

The laboratory will be open for work for the entire day, and the members of the class are expected to be present for instruction from immediately after the lecture until the dinner hour, and during a part of the afternoon.

Outdoor study of the life-history and habits will be supplemented by excursions on Saturdays in the steam-launch and boats of the laboratory.

The type-forms to be taken up will be nearly as follows :

Marine Protozoa.

Porifera—*Grantia*, *Leucosolenia*.

Cnidaria—*Campanularia*, *Pennaria*, *Gonionemus*, *Metridium*, *Cyanea*.

Platoda—*Syncoelidium*, *Bdelloura*, *Polychaerus*.

Vermes—*Nereis*, *Phascolosoma*, *Bugula*.

Mollusca—*Venus*, *Sycotypus*, *Loligo*.

Echinodermata—*Asterias*, *Arbacia*, *Thyone*.

Crustacea—*Homarus*, *Cancer*, *Orchestia*, *Lepas*, etc.

Tunicata—*Molgula*, *Perophora*, *Botryllus*.

The fee for the course is \$50.00, payable in advance. It covers tuition, material for dissection, laboratory outlines, and a supply of glassware and reagents. The laboratory loans, without charge, all necessary apparatus; there is a small fee, however, for the use of microscopes, and all who can provide themselves with simple and compound microscopes before coming to Wood's Holl are urged to do so.

Applications should be made to PROFESSOR ULRIC DAHLGREN, Princeton University Princeton, N. J. (June 15 to September, at Wood's Holl, Mass.)

5. GENERAL AND COMPARATIVE PHYSIOLOGY

This course will be conducted by Dr. Loeb, assisted by Dr. Norman, Lyon, and Mathews, and will consist of laboratory work and lectures. The following is a brief outline of the work:

I. The Tropisms of Animals. Galvanotropism, Heliotropism, Geotropism and Compensatory Motions, Chemotropism, Heterotropism in sessile and free forms.

II. Effects of External Influences upon Living Matter (lack of oxygen, acids, and alkalies, temperature, etc.).

III. Physiological Morphology. Experiments on Growth and Development, Regeneration, and Heteromorphosis.

IV. Comparative Physiology of the Central Nervous System and Comparative Psychology.

V. Comparative Physiology of Digestion.

VI. Comparative Physiology of Secretion.

VII. Micro-chemistry.

The fee for the course is \$50.00. Applications should be made to Dr. Jacques Loeb, the University of Chicago.

6. COMPARATIVE PSYCHOLOGY

Dr. Eduard Thorndike will give a course of lectures on the Sense-powers, Instincts, Habits, and Intelligence of Animals, and will direct the research work of a few students in this department. Applications should be sent to Dr. Thorndike, Western Reserve University, Cleveland, Ohio.

BOTANY

JULY 5---AUGUST 16

The Department of Botany provides,

First: Lectures in Morphology and Physiology, and a course of study on the Cryptogams.

Second: A course of lectures on the *Algae*, with opportunities to study a great variety of types.

Third: A course in Cytology for advanced students.

Fourth: For investigation under the general guidance of the staff of instructors.

EQUIPMENT AND FEES

The work of the department is conducted in a special building, containing one laboratory for elementary work, one for advanced work, and seven research rooms. Students are expected to supply their own microscopes, but a limited number will be rented for the season at \$5.00 apiece. The tuition fee, which allows the student to take any courses and attend all lectures, is \$50.00, payable in advance. Investigators' tables are rented for \$50.00 and investigators' rooms for \$100.00.

APPLICATION FOR ADMISSION

Application for admission should be made to Dr. Bradley M. Davis, the University of Chicago Chicago, Ill.

The application should state the courses which the student desires to take, according to the program outlined below, or the line of research proposed. The course on *Algae* or that in Cytology will fully occupy the attention of an advanced student. The latter will demand first-class microscopes and immersion lenses.

7. A COURSE OF LECTURES ON PLANT MORPHOLOGY AND PHYSIOLOGY

First Week, July 5-12.

ERWIN F. SMITH,
D. T. MACDOUGAL,
DOUGLAS H. CAMPBELL,

Bacteria.

Physiological subjects.

*The Evolution of the Sporophyte in the Archegoniates
and Flowering Plants.*

Second Week, July 12-19.

MISS CLARA E. CUMMINGS.
L. M. UNDERWOOD,
RODNEY H. TRUE,

Lichens.

The Evolution of the Hepaticae.

Plants and Poisons.

Third Week, July 19-26.

H. J. WEBBER,

*Spermatogenesis, Development of Embryo-Sac, and
Fecundation in Gymnosperms.*

Physiology of the Plant Cell.

Fourth Week, July 26-August 2.

J. M. MACFARLANE,
G. F. ATKINSON,

Plant Irritability.

Higher Fungi.

Fifth Week, August 2-9.

J. M. MACFARLANE,
HENRY KRAEMER

Physio-morphology of a Few Angiospermic Orders.

The Unorganized Contents of the Cells of Plants.

Sixth Week, August 9-16.

D. M. MOTTIER,

D. P. PENHALLOW,

*Cytological Studies on the Pollen and Embryo-sac of
Angiosperms.*

Paleobotany.

8. CRYPTOGAMIC BOTANY

(GIVEN BY DR. DAVIS AND MR. MOORE)

The laboratory work in this course may be arranged to suit the needs of individual students. The advantages offered for the study of Marine Algae are such that the greatest encouragement is given to work in this field of cryptogamic botany. However, the course may be made a general one by following a program of selected types that include *Fungi* and various forms of higher Cryptogams. Mr. Moore will direct a special course of study upon the *Fungi* for students desiring to devote their attention exclusively to this group.

Daily lectures (at 10:30), dealing chiefly with the morphology and development of the *Algae* accompany the laboratory work.

9. PLANT CYTOLOGY AND MICRO-TECHNIQUE

A laboratory course directed by Dr. Davis. The entire session may be spent by the student in the study of cell and nuclear activities and the structure of protoplasm in several types of plants such as the Lily, *Anthoceros*, *Sphacelaria*, *Fucus*, and other algal and fungal forms. The course is designed to give the student practical acquaintance with the methods of Plant Cytology. The laboratory will have sets of slides that may serve as a guide and enable the student to study the subject-matter of the course while the technique is being mastered. The work of the course is supplemented by the lectures of the Botanical Seminar upon cytological subjects.

THE BOTANICAL SEMINAR

Investigators in the laboratory and members of the staff contribute lectures during the session on subjects under investigation, which embody the results of their research. These lectures are followed by informal discussions.

INVESTIGATION

Wood's Holl offers exceptional advantages for research on the Marine Algae of the north temperate Atlantic. The opportunities are also equally good for research in other groups of plants, especially upon cytological problems, and the study of life-histories.

BOTANICAL SUPPLY DEPARTMENT

A Supply Department has been organized to furnish type material for instruction in botany in high schools and colleges.

We cannot undertake to keep material in stock, and will only promise to fill orders to the best of our ability that are sent to us early in the season.

Address, Dr. Bradley M. Davis, The University of Chicago, Chicago, Ill.

SEMINARS AND GENERAL LECTURE COURSES

I. THE NEUROLOGICAL SEMINAR

Was organized in 1896 under the direction of Dr. Ayers, and has since been conducted by Professor Morrill. The reports of members in 1898 have been published in the November number of the *Journal of Comparative Neurology*, pp. 149-247.

2. THE BIOLOGICAL SEMINAR

A special topic for consideration in the summer of 1899 will be *Coloration in Animals*. The work will consist of reviews, original communications, lectures, and demonstrations. Illustrated lectures on Coloration and Phosphorescence will be contributed by W. H. Dudley, A. G. Mayer, A. E. Ortmann, C. O. Whitman, S. Watasé, and W. M. Wheeler.

3. BOTANICAL SEMINAR

The work includes lectures, communication of results of original work and discussions.

4. LECTURES ON ZOÖLOGICAL TECHNIQUE

A series of lectures on the following subjects will be given in connection with the course in Morphology and for the benefit of those in other departments:

1. Optical and mechanical features of the microscope and how to select a microscope for any particular work.
2. Cytological and histological methods for preparing tissues.
3. Drawing methods.
4. Preparation of MSS. for the press, and proof correction.
5. Museum methods for systematic and morphological exhibits.

This series of lectures will be conducted by the assistant director and members of the staff, together with others who are specialists on the several subjects.

5. EVENING LECTURES

The evening Lectures are designed to present the results of research in different lines and departments, in so far as these are of general interest. *The Biological Lectures*, published annually, are selected from those of this course.

